AD-A048 869 NAVY ELECTRONICS LAB SAN DIEGO CALIF F/G 20/1

TRANSMISSION OF 56-KC SOUND IN SHALLOW WATER OVER A SAND BOTTOM--ETC(U)

JUL 47 M J SHEEHY

UNCLASSIFIED NEL-15 NL

| OF |

AD
A048869

END

DATE
FILMED

2-78

DDC

File Indexed Reports

MOST Project - 2 USNEL REPORT NO. 15 24

DPS INDEX NO. 212-2.2

BUSHIPS PROBLEM NO. D17.3

DATE: 18 JULY 1947

942 File Copy

AD No. ___ DDC FILE COPY AD A048869 91172

NOT CAT.

(6)

(9) INTERIM REPORT,

TRANSMISSION OF 56-KC. SOUND IN SHALLOW WATER OVER A SAND BOTTOM.

(1) NW

(10) MYLES J. SHEEHY
RESEARCH DEPARTMENT

(11) 18 Jul 47

(12) 7p

(14) NEL-15

SAN DIEGO, CALIFORNIA

15

253550

(A)

Preface

The transmission studies carried out by the Echo Ranging Section of the University of California Division of War Research supplied considerable information on the propagation of 24-kc. sound in both deep and shallow water and on 56-kc. propagation in deep water. Only a very few experiments were carried out, however, using 56-kc. sound in shallow water.

It is the purpose of this report ~~to~~ be presents the results of 46 transmission runs made in 15-fathom water over a ~~SAND~~ bottom at 56 kc., More data of this type will be taken in the future but the following preliminary results are believed to be of interest: offered:

(1.) On the average the transmission anomaly increased linearly with range regardless of the thermal structure. The average rate of increase of the anomaly (the attenuation coefficient) was 13.2 ± 0.2 db per 1000 yards for 'MIKE' thermal structure and 15.7 ± 0.1 db per 1000 yards for 'NAN' structure; + or -

(2.) There was no significant difference between the attenuation coefficient measured by a hydrophone at a depth of 16 feet and by one at a depth of 50 feet; and

(3.) The average attenuation coefficient when the data were not grouped according to thermal structure was 14.7 ± 0.6 db per 1000 yards.

These data were taken by the Measurements Group of the Propagation Section under the supervision of T. McMillian, the Section Chief. The data were analyzed by M. J. Sheehy, Mrs. M. R. Miller, and Miss J. J. Smith, the last named of whom prepared the illustrations.

B

Data

The data consisted of forty-six runs made about 6 to 8 miles south and slightly east of Point Loma during January, February, and April, 1947. Two hydrophones were used on each run, one at a depth of 16 feet and the other at 50 feet, except for eight runs when the deeper hydrophone was at a depth of 70 feet. There were thus ninety-two hydrophone runs available for analysis, but, owing to certain experimental difficulties associated with six runs, only eighty-six were actually used.

The water depth varied from 10 to 21 fathoms with an average value of 15 fathoms. The SAND bottom was essentially flat during any one run.

Of the forty-six runs, twelve were made under MIKE thermal conditions, two under CHARLIE, and thirty-two under NAN.

Analysis

It was found in an earlier report[1] that 56-kc. transmission in deep water could be classified quite well by NAVSHIPS 943-C2 methods.[2] It is possible that further

---

1. Sonar Data Division, UCDWR, "The Transmission of Sound at 56 Kc." UCDWR File Report No. M378, 28 November 1945.
2. BuShips, Navy Department, "Prediction of Sound Ranges from Bathythermograph Observations," NAVSHIPS 943-C2, March 1944, p. 15. The definition of MIKE and NAN thermal patterns are given below for the reader's convenience:

   MIKE: Temperature difference from 0 to 30 feet $\leq$ 0.3 degree Fahrenheit.

   NAN: Temperature difference from 0 to 30 feet > 1/100 surface temperature, and temperature difference from 15 to 50 feet $\geq$ 0.3 degree Fahrenheit.

study may reveal some better method of classifying transmission at this frequency, but in this preliminary report the 943-C2 methods were used.

The runs were grouped according to thermal structure and hydrophone depth and average transmission curves obtained. These curves are shown in figures 1 and 2, and the data for the curves are given in table 1. The CHARLIE data are not presented in this report because this thermal structure was encountered on only two of the runs.

The averaging was not carried to longer ranges because there were not enough runs at longer range to provide a reliable average.

Since a value of the anomaly could not always be obtained at each range on each run, the number N, which is the total number of observations yielding the associated

TABLE 1

Average Transmission Anomaly Versus Range, Hydrophone Depth, and Thermal Structure Dependence

(N = No. of observations, M = mean anomaly, σ = standard deviation of observations)

Thermal Structure	Hydrophone Depth (feet)	Measures	Range (yards)						
			200	400	600	1000	1500	2000	2500
[illegible]	16	N	8	11	12	11	11	11	11
		M	3.4	3.4	6.4	12.1	18.2	24.8	31.9
		σ	2.9	[illegible]	3.2	[illegible]	4.8	5.4	6.4
	50-70	N	7	10	11	[illegible]	10	10	10
		M	2.7	7.4	[illegible]	[illegible]	17.7	23.8	29.4
		σ	3.5	[illegible]	3.7	2.5	2.8	2.4	3.7
NAN	16	N	29	29	29	[illegible]	31	30	29
		M	4.5	[illegible]	[illegible]	16.1	[illegible]	33.1	[illegible]
		σ	4.4	4.1	4.2	5.4	[illegible]	[illegible]	[illegible]
	50-70	N	24	25	25	26	26	26	24
		M	2.9	4.3	8.0	16.1	23.4	[illegible]	37.2
		σ	3.5	3.8	3.9	[illegible]	4.6	6.3	[illegible]

mean anomaly, is not always the same in the tables as the total number of hydrophone runs in each category. Also, the standard deviation given in the tables is not the error in the mean value, but is the dispersion of the individual observations about their mean.

Straight lines were fitted by the least squares method to the points beyond 400 yards on figures 1 and 2. The slopes of these lines are the attenuation coefficients and there is no significant difference between them for the two depths for either thermal structure. The fact that the 50-foot curve lies above the 16-foot curve in both cases is probably due to some systematic error in calibration.

TABLE 2

Average Transmission Anomaly Versus Range—Thermal Structure Dependence

(N = No. of observations, M = mean anomaly, σ = standard deviation of observations)

Thermal Structure	Measures	Range (yards)						
		200	400	600	1000	1500	2000	2500
MIKE	N	15	21	23	21	21	21	21
	M	3.1	5.5	5.8	11.0	18.0	24.4	30.7
	σ	3.9	4.3	3.5	3.6	3.8	3.9	5.5
NAN	N	53	54	54	57	57	56	58
	M	3.8	5.9	9.1	16.1	24.6	31.3	39.2
	σ	4.1	4.2	4.2	4.6	5.2	7.1	6.7

Figures 1 and 2 do show a difference, however, between the attenuation for MIKE structure and that for NAN. Consequently, the data were grouped by thermal structure alone and the average curves of figure 3 were obtained. The data for these curves are given in table 2.

Straight lines were fitted to these data also by the method of least squares, but, inasmuch as the short range data for the 50-foot hydrophone were affected by projector directivity, only the points from 400 yards out were used. (The point at 400 yards on the MIKE curve was not used

AVERAGE TRANSMISSION ANOMALIES VERSUS RANGE

56 Kilocycles - Shallow Water - Sand Bottom

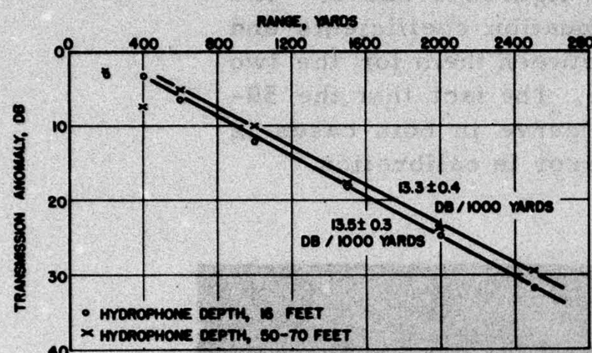

Figure 1. MIKE thermal structure.

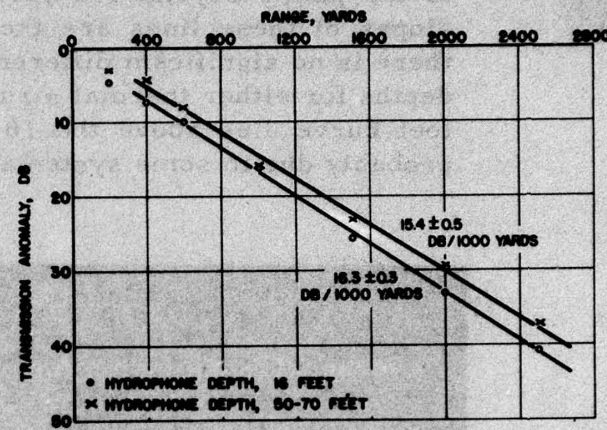

Figure 2. NAN thermal structure.

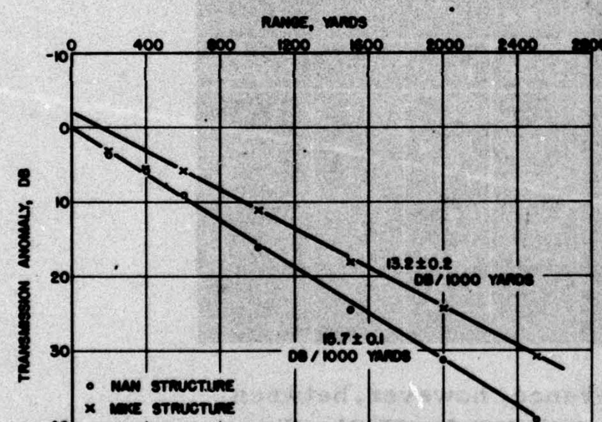

Figure 3. Data for hydrophone depths of from 16 to 70 feet averaged according to NAN and MIKE thermal structures.

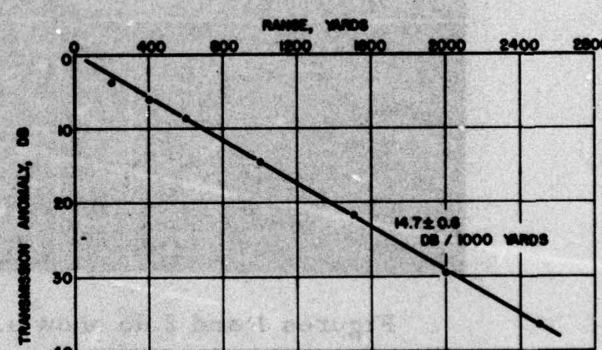

Figure 4. Data averaged as a whole for NAN and MIKE thermal structures and hydrophone depths of from 16 to 70 feet.

owing to the adverse effect of two runs which had an anomalous decrease of intensity at this range. This decrease was temporary and was believed to be caused by experimental difficulties.)

The attenuation coefficients given by the least squares lines were 13.2 ± 0.2 db per 1000 yards for the MIKE data and 15.7 ± 0.1 db per 1000 yards for the NAN data. Statistically, this difference is, of course, highly significant. The zero-range intercept of -2 db for the MIKE data is probably a result of some systematic error in calibration.

The attenuation coefficient for 56-kc. sound near the surface in deep water with MIKE thermal structure was found in reference 1 to be 13.5 db per 1000 yards. This is essentially the same as the value of 13.2 db per 1000 yards found here for shallow water and a SAND bottom under comparable thermal conditions.

Finally, in order to get a single average value for the attenuation coefficient, the data were taken as a whole and the average curve of figure 4 was obtained. The data are given in table 3.

[redacted]

A straight line was fitted to these data, also, by the method of least squares and gave an attenuation of 14.7 ± 0.6 db per 1000 yards.

As soon as ship facilities are again available, more data of this type will be taken, including data over different bottom types and in different depths of water.